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## Two New Species of the *Macrocheles carinatus* Group (Acari: Macrochelidae) from Northern Japan

Gen Takaku

*Division of Biological Sciences, Graduate School of Science,  
Hokkaido University, Sapporo 060, Japan*

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Two new species of the genus *Macrocheles*, *M. coenosus* and *M. subcoenosus*, are described and illustrated on the basis of material collected in Hokkaido, northern Japan. These species are assignable to the *carinatus* species group of the genus, and this is the first record of the group from Japan.

**Key Words:** *Macrocheles coenosus* sp. nov., *Macrocheles subcoenosus* sp. nov., *carinatus* species group, leaf-litter species, northern Japan.

### Introduction

The mites of the genus *Macrocheles* may be roughly grouped into two categories, i.e. leaf-litter species and phoretic species, on the basis of their habitat. The species of the *carinatus* group of the genus have been known as litter dwellers (Hyatt and Emberson 1988), and eight species assignable to the species group have been described until now. In this paper, two species of the *carinatus* species group collected in northern Japan are described as new to science.

All specimens were extracted from soil and litter samples by means of a modified Tullgren funnel extractor. Extraction was made for 24 hours with a 20-watt bulb. All extracted specimens were fixed with 70% ethyl alcohol and mounted in gum-chloral medium after clearing in lactophenol. Observations and measurements were made with a phase-contrast microscope, and illustrations were prepared with the aid of a drawing apparatus.

In this paper, all measurements are given in micrometers ( $\mu\text{m}$ ). Dorsal chaetotaxy follows Evans and Till (1979). The holotypes and a part of paratypes will be deposited in the Natural History Museum, London. Other paratypes will be placed in the following collections: Zoological Collection of Graduate School of Science, Hokkaido University, Sapporo; Oregon State University, Corvallis; National Science Museum (Nat. Hist.), Tokyo.

Family **Macrochelidae** Vitzthum, 1930

Genus ***Macrocheles*** Latreille, 1829

***Macrocheles coenosus*** sp. nov.

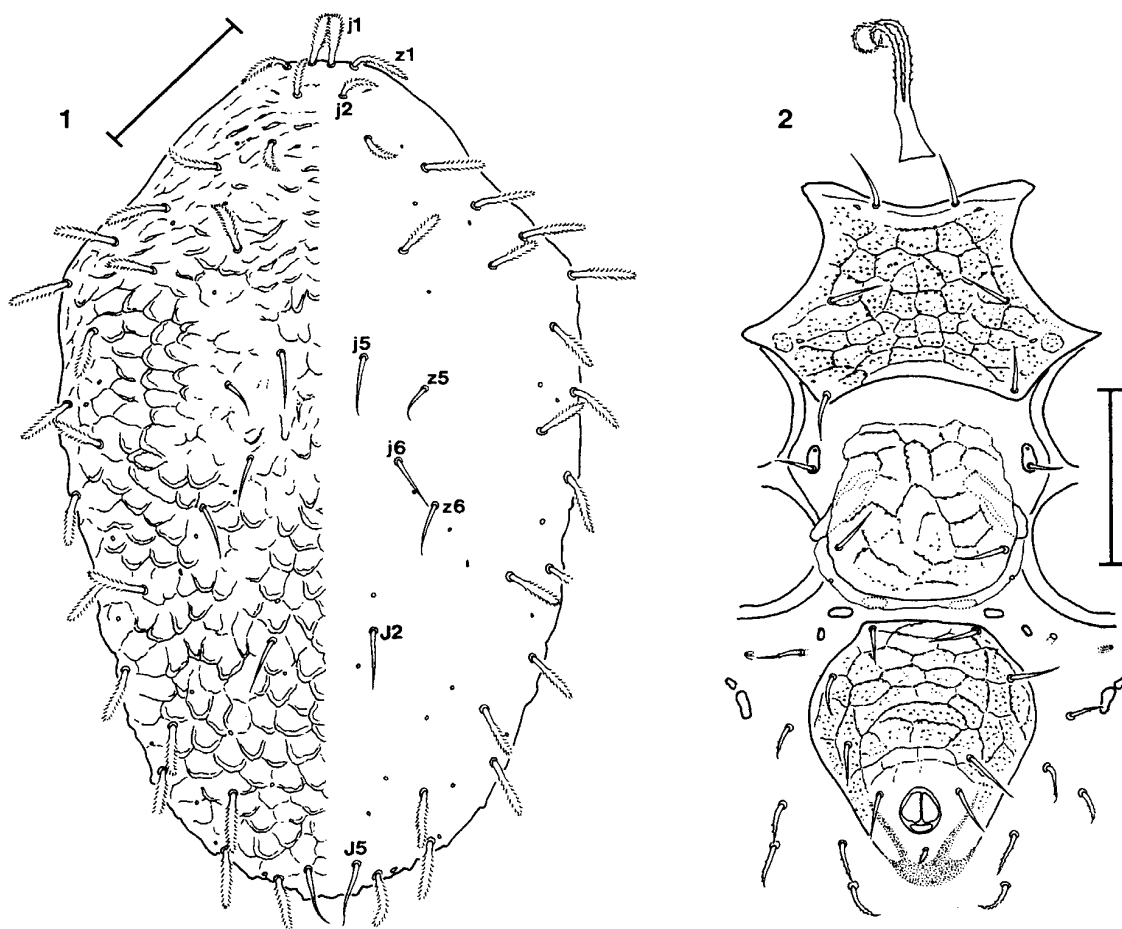
[Japanese name: Tsuchi-haedani, new]

**Female:** Length of idiosoma, 1077-1257 ( $1167.3 \pm 56.2$ ,  $n=17$ ); width at level of coxae IV, 648-816 ( $713.9 \pm 47.2$ ,  $n=17$ ). Length of dorsal shield, 1061-1245 ( $1158.5 \pm 55.3$ ,  $n=17$ ); width at level of coxae III, 612-775 ( $674.3 \pm 48.0$ ,  $n=17$ ). Dorsal shield yellowish or reddish brown and covered with soil in nature.

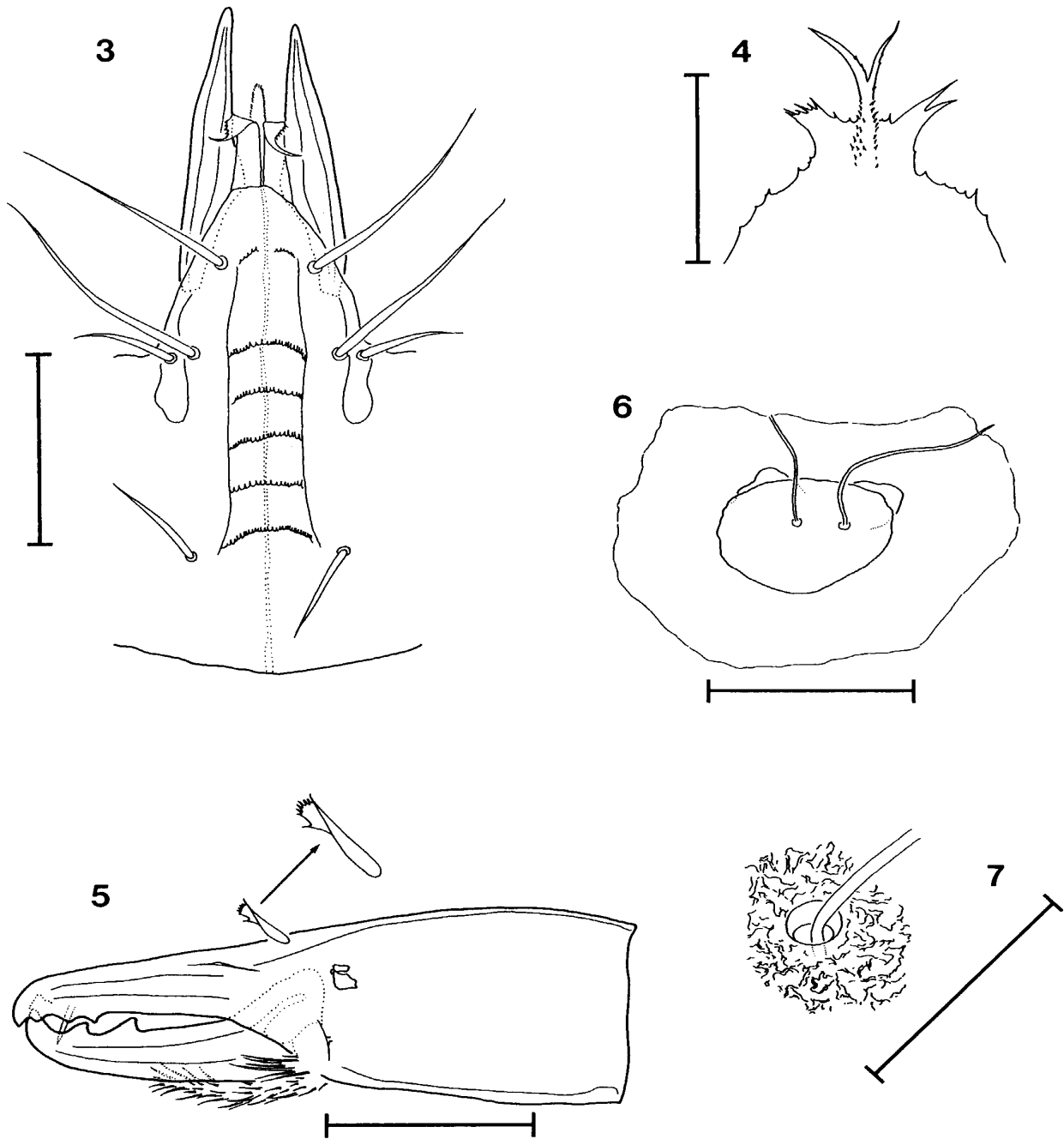
**Dorsum** (Fig. 1): Dorsal shield (Fig. 1) ornamented with sclerotized reticulation; the reticulation weak in the central region of the shield; lateral and posterior margin irregularly crenulate; the shield bearing 28 pairs of dorsal setae and 22 pairs of dorsal pores; vertical setae j1 broad and strongly plumose; z1 plumose, long and reaching or surpassing the base of j2; setae of dorsal hexagon (j5, j6 and z5), z6, J2 and J5 simple; the other dorsal setae and extra-marginal setae distinctly plumose in their distal two thirds.

Length of setae: j1, 63-78 ( $70.5 \pm 4.3$ ,  $n=16$ ); j4, 51-71 ( $66.3 \pm 5.5$ ,  $n=14$ ); j5, 75-92 ( $82.3 \pm 5.1$ ,  $n=15$ ); j6, 53-73 ( $65.3 \pm 5.2$ ,  $n=14$ ); z1, 46-77 ( $63.2 \pm 8.5$ ,  $n=17$ ); z5, 43-61 ( $51.1 \pm 5.8$ ,  $n=17$ ).

**Venter** (Fig. 2): Tritosternum well developed, with a pair of pilose laciniae. Sternal shield with 3 pairs of setae and 2 pairs of pores; all the setae simple; surface of the shield with polygonal ornamentation and punctation; length of the shield



Figs 1–2: *Macrocheles coenosus* sp. nov., female (holotype). 1: Dorsum. 2: Venter. Scale bars = 200  $\mu\text{m}$ .



Figs 3–7: *Macrocheles coenosus* sp. nov., female (holotype). 3: Ventral view of gnathosoma (scale bar=100  $\mu$ m). 4: Tectum (scale bar=100  $\mu$ m). 5: Chelicera (scale bar=100  $\mu$ m). 6: Michael's organ (paratype) (scale bar=200  $\mu$ m). 7: Ramus of Michael's organ (paratype) (scale bar=50  $\mu$ m).

192-241 ( $209.3 \pm 12.7$ ), width at level of coxae II 192-228 ( $206.6 \pm 9.4$ ) ( $n=17$ ). Metasternal shield small and oblong, with a seta and a pore; the setae simple or slightly pilose distally. Epigynial shield punctate, with a pair of setae and a pair of sclerites; the setae simple or slightly pilose distally. Three pairs of small platelets located posterior to genital shield; anteriormost pair of platelets larger than the others; the platelets without any setae.

Ventrianal shield longer than wide; length of the shield 302-375 ( $341.0 \pm 24.9$ ), width 228-294 ( $258.7 \pm 16.8$ ) ( $n=17$ ); the shield with 3 pairs of preanal setae, a pair of paranal setae and a postanal seta; all the setae long and simple except for short and plumose postanal seta; surface of the shield with polygonal ornamentation and punctation; cribrum mainly located posterior to postanal seta, but anterolateral extensions of cribrum reaching the level of paranal setae. Opisthogaster with one or two pairs of metapodal shields and a pair of postcoxal pores; opisthogastric setae pilose distally.

Peritrematic shield well developed; the shield not fused with expodal shield; stigmata located at a level between coxae III and IV.

*Gnathosoma* (Figs 3-5): Well developed and sclerotized. Three pairs of hypostomatic setae and a pair of palpcoxal setae present; all the setae simple and long. Deutosternal groove with 5 rows of denticles. Palpal chaetotaxy of trochanter, femur and genu 2-5-6. Palptarsus with a trifold apotele. Tectum (Fig. 4) with a median lobe and lateral processes; median lobe bifurcated distally and with many small spicules; lateral processes fused basally; extremities of lateral processes irregularly divided; lateral margin serrate. Fixed digit of chelicera (Fig. 5) with three teeth, a *pilus dentilis*, a terminal hook and a dorsal seta; the seta membranous and serrate laterodistally; movable digit with two large teeth and a terminal hook; arthrodial process strongly pilose; length of fixed digit 294-326 ( $313.7 \pm 8.5$ ); length of movable digit 145-163 ( $154.1 \pm 4.6$ ) ( $n=15$ ).

*Legs*: Tarsus I without ambulacrum and claw; tarsi II to IV with well-developed ambulacra and claws; ambulacral operculi long and the distal margin deeply branched. Segments of each leg with some plumose setae, except for coxa, trochanter and tarsus I, which have only simple setae.

Leg chaetotaxy (coxa, trochanter, femur, genu and tibia) as follows:

Leg I: 0, 0/1, 0/1, 0; 1, 0/1, 0/2, 1; 2, 3/1, 2/3, 2; 2, 3/1, 2/1, 2; 2, 3/2, 2/1, 2.

Leg II: 0, 0/1, 0/1, 0; 1, 0/1, 0/2, 1; 2, 3/1, 2/2, 1; 2, 3/1, 2/1, 2; 2, 2/1, 2/1, 2.

Leg III: 0, 0/1, 0/1, 0; 1, 1/1, 0/1, 1; 1, 2/1, 1/0, 1; 1, 2/1, 2/0, 1; 1, 1/1, 2/1, 1.

Leg IV: 0, 0/0, 0/1, 0; 1, 1/2, 0/1, 0; 1, 2/1, 1/0, 1; 1, 2/1, 2/0, 0; 1, 1/1, 2/1, 1.

Leg length (except ambulacrum,  $n=17$ ): Leg I, 865-1036 ( $950.9 \pm 45.3$ ); leg II, 816-987 ( $918.7 \pm 45.0$ ); leg III, 816-947 ( $880.3 \pm 39.2$ ); leg IV, 1232-1510 ( $1386.8 \pm 70.6$ ).

*Michael's organ* (Figs 6, 7): Surface of the *sacculus foemineus* finely wrinkled; the *sacculus* not divided and without discrete *cornu*; *ramus* not sclerotized (Fig. 7).

**Type-series**: Holotype female and 8 paratype females, 14 September 1992; 3 paratype females, 29 May 1992; 3 paratype females, 2 June 1993, larch forest at the foot of Mt. Hakken, Sapporo, Hokkaido, Japan, G. Takaku leg. — Two paratype females, 12 September 1995, grove of broadleaf tree in Hokkaido University, Sapporo, Hokkaido, Japan, G. Takaku leg.

**Etymology**: The species name is derived from the Latin word *coenosus* which means "covered with mud," since the body surface is always covered with soil.

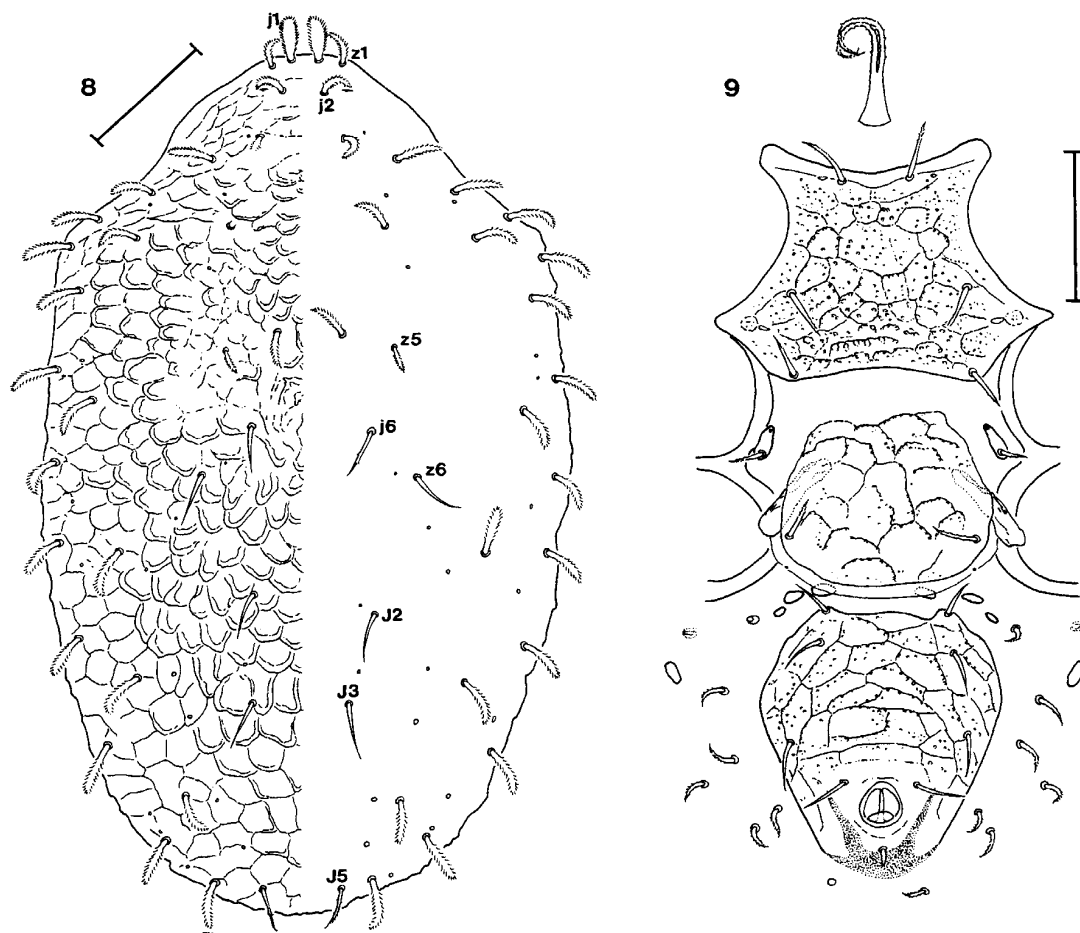
***Macrocheles subcoenosus* sp. nov.**

[Japanese name: Nisetsuchi-haedani, new]

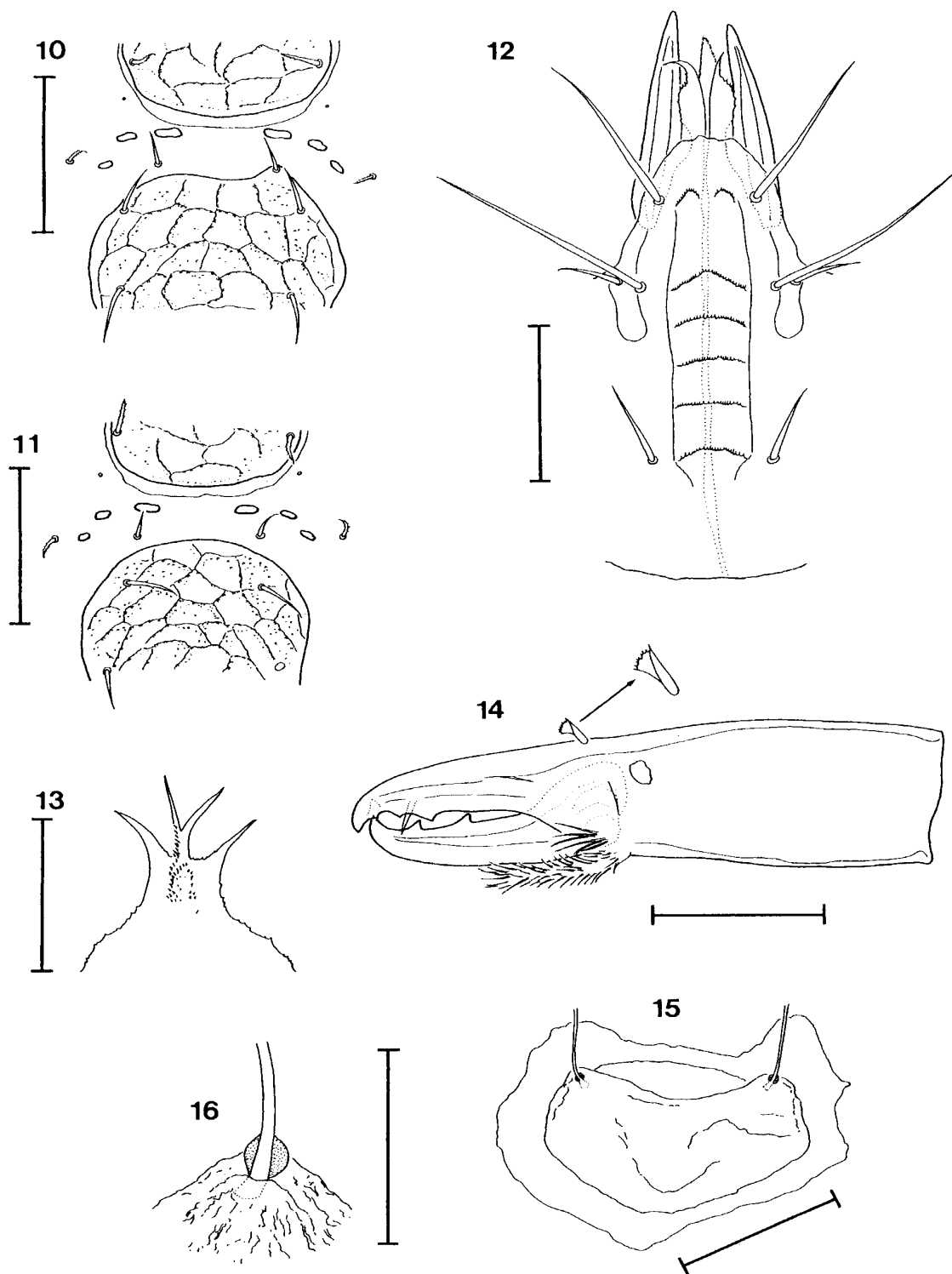
**Female:** Length of idiosoma, 1208-1404 ( $1316.0 \pm 56.7$ ,  $n=14$ ); width at level of coxae IV, 702-832 ( $758.9 \pm 37.5$ ,  $n=14$ ). Length of dorsal shield, 1142-1363 ( $1296.7 \pm 62.4$ ,  $n=14$ ); width at level of coxae III, 612-775 ( $715.6 \pm 44.4$ ,  $n=14$ ). Dorsal shield yellowish or reddish brown and covered with soil in nature.

**Dorsum** (Fig. 8): Dorsal shield (Fig. 8) ornamented with sclerotized reticulation; the reticulation indistinct in the region of dorsal hexagon; lateral and posterior margin irregularly crenulate; the shield with 29 pairs of dorsal setae and 22 pairs of dorsal pores; setae J3 present; vertical setae j1 broad and strongly plumose; z1 plumose, long and reaching or surpassing the base of j2; j6, z6, J2, J3 and J5 simple or slightly pilose; z5 short and plumose; the other dorsal setae and extra-marginal setae distinctly plumose in their distal two thirds.

Length of setae: j1, 65-75 ( $69.4 \pm 3.2$ ,  $n=14$ ); setae j4, 43-71 ( $55.9 \pm 10.1$ ,  $n=11$ ); j5, 41-61 ( $52.2 \pm 5.4$ ,  $n=12$ ); j6, 73-92 ( $81.3 \pm 5.2$ ,  $n=13$ ); z1, 38-66 ( $52.5 \pm 8.1$ ,  $n=13$ ); z5, 27-42 ( $34.9 \pm 5.4$ ,  $n=13$ ).



Figs 8–9: *Macrocheles subcoenosus* sp. nov., female (holotype). 8: Dorsum. 9: Venter. Scale bars = 200  $\mu\text{m}$ .



Figs 10–16: *Macrocheles subcoenosus* sp. nov., female (holotype). 10, 11: Variations in the position of ventrianal setae Jv1 (paratypes) (scale bars=200  $\mu$ m). 12: Ventral view of gnathosoma (scale bar=100  $\mu$ m). 13: Tectum (scale bar=100  $\mu$ m). 14: Chelicera (scale bar=100  $\mu$ m). 15: Michael's organ (scale bar=200  $\mu$ m). 16: *Ramus* of Michael's organ (scale bar=50  $\mu$ m).

**Venter** (Figs 9-11): Tritosternum well developed, with a pair of pilose laciniae. Sternal shield with 3 pairs of setae and 2 pairs of pores; all the setae pilose distally; surface of the shield with polygonal ornamentation and punctation; length of the shield 212-265 ( $250.6 \pm 15.0$ ), width at level of coxae II 212-237 ( $223.0 \pm 7.7$ ) ( $n=14$ ). Metasternal shield small and oblong, with a seta and a pore; the shield absent in some specimens, but metasternal seta and pore always present; metasternal setae pilose distally. Epigynial shield punctate, with a pair of setae and a pair of sclerites; the setae pilose distally. Three pairs of small platelets located posterior of genital shield; the platelets without any setae.

Ventrianal shield longer than wide; length of the shield 282-396 ( $350.5 \pm 30.2$ ), width 224-326 ( $287.9 \pm 27.4$ ) ( $n=14$ ); numbers of preanal setae on the shield variable from 2 pairs to 3 pairs (Figs 9-11); preanal setae Jv1 present on the shield or integument between the shield and the platelet; preanal setae Jv1 and Jv3 simple; Zv2 simple or slightly pilose; a pair of simple paranal setae and a plumose postanal seta present on the shield; surface of the shield ornamented with polygonal reticulation and punctation; cribrum mainly located posterior to postanal seta, but anterolateral extensions of cribrum reaching the level of paranal setae. Opisthogaster with one or two pairs of metapodal shields and a pair of postcoxal pores; opisthogastric setae pilose distally.

Peritrematic shield well developed; the shield not fused with expodal shield; stigmata located at a level between coxae III and IV.

**Gnathosoma** (Figs 12-14): Well developed and sclerotized. Three pairs of hypostomatic setae and a pair of palpcoxal setae present; all the setae simple and long. Deutosternal groove with 5 rows of denticles. Palpal chaetotaxy of trochanter, femur and genu 2-5-6. Palptarsus with a trifid apotele. Tectum (Fig. 13) with a median lobe and lateral processes; median lobe bifurcated distally and with many small spicules; lateral processes fused basally; lateral margin of the base serrate. Fixed digit of chelicera (Fig. 14) with three teeth, a *pilus dentilis*, a terminal hook and a dorsal seta; the seta membranous and serrate laterodistally; movable digit with two large teeth and a terminal hook; arthrodial process strongly pilose; length of fixed digits 326-355 ( $343.6 \pm 8.1$ ); length of movable digits 151-161 ( $156.0 \pm 3.1$ ) ( $n=14$ ).

**Legs:** Tarsus I without ambulacrum and claw; tarsi II to IV with well-developed ambulacra and claws; ambulacral operculi long and the distal margin deeply branched. Segments of each leg with some plumose setae, except for coxa, trochanter and tarsus I, which have only simple setae. Leg chaetotaxy same as that of *M. coenosus*.

Leg length (except ambulacrum,  $n=13$ ): Leg I, 930-1126 ( $1026.9 \pm 61.2$ ); leg II, 865-1061 ( $979.8 \pm 63.0$ ); leg III, 840-1020 ( $934.6 \pm 66.4$ ); leg IV, 1265-1616 ( $1507.7 \pm 101.7$ ).

**Michael's organ** (Figs 15, 16): Surface of the *sacculus foemineus* wrinkled finely; the *sacculus* not divided and without discrete *cornu*; *ramus* sclerotized (Fig. 16).

**Type-series:** Holotype female and 5 paratype females, 2 June 1993; 8 paratype females, 14 September 1992, larch forest at the foot of Mt. Hakken, Sapporo, Hokkaido, Japan, G. Takaku leg.

**Etymology:** The species name refers to morphological similarities between the new species and *Macrocheles coenosus*.

### Remarks

The two new species described above are assigned to the *carinatus* species group of the genus *Macrocheles*, since they share the following characters with known species of the group: 1) Dorsal shield with 28 or 29 pairs of setae; 2) most of the dorsal setae plumose in their distal two thirds, but some pairs of dorsal setae simple; 3) dorsal shield ornamented with reticulate pattern; 4) three pairs of small platelets present posterior to epigynial shield; 5) tectum with lateral processes and a median lobe, and lateral processes fused basally; 6) median lobe of tectum with many spicules; 7) a dorsal seta of fixed digit membranous and serrate laterodistally. This is the first record of the *M. carinatus* species group from Japan.

The two species are very similar to each other in the ornamentation of dorsal and ventral shields and in the type of dorsal setae, but *M. coenosus* is distinguishable from *M. subcoenosus* as follows (corresponding conditions of *M. subcoenosus* in parentheses): Dorsal shield with 28 pairs of setae (29 pairs); dorsal setae j5, j6, J2, J5, z5 and z6 simple (j6, J2, J3, J5 and z6 simple); sternal setae simple (pilose distally); preanal setae simple (sometimes pilose distally); *ramus* of Michael's organ not sclerotized (sclerotized).

Hitherto, eight species assignable to the *carinatus* group have been described. A tabular key to these eight species and the present two species is presented in Table 1.

### Acknowledgments

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Table 1. Tabular key to the species of the *carinatus* species group in the genus *Macrocheles* (data cited from Bregetova and Koroleva 1960, Evans and Browning 1956, Hyatt and Emberson 1988 and Iavorschi 1977).

	Number of dorsal setae	Simple setae on dorsal shield	Dorsal setae z1*	Sternal setae	Metasternal setae	Epigynial setae	Ventrianal shield L/W**	Preanal setae
<i>M. banaticus</i> Iavorschi, 1977	28 pairs	J2, z1, z6	long	simple	simple	simple?	1.22 (462/378)	simple or slightly pilose
<i>M. biharicus</i> Iavorschi, 1977	29 pairs	j5, j6, J2, J3, J5, z5, z6	short	simple	simple	simple	1.14 (378/333)	simple
<i>M. carinatus</i> (C.L.Koch, 1839)	28 pairs	j6, J2, J5, z5, z6	short	simple	simple	simple	—	simple
<i>M. caucasicus</i> Bregetova & Koroleva, 1960	29 pairs	j5, j6, J2, J3, J5, z1, z5, z6	short	simple	simple	simple	—	simple
<i>M. margaretae</i> Iavorschi, 1977	29 pairs	j6, J2, J3, J5, z1, z5, z6	long	plumose	plumose?	plumose	—	simple
<i>M. montanus</i> (Willmann, 1951)	29 pairs	j5, j6, J2, J3, J5, z1, z5, z6	short	simple or slightly plumose	simple	simple	1.05 (357/340)	simple
<i>M. submotus</i> Falconer, 1923	28 pairs	j2, j5, j6, J2, J5, z1, z5, z6, s2, r3, r4	long	simple	simple	simple	1.05 (450/430)	simple
<i>M. tardus</i> (C.L.Koch, 1841)	28 pairs	j6, J2, J5, z1, z5, z6	long	simple	plumose	simple	1.10 (330/300)	simple or pectinate
<i>M. coenosus</i> Takaku, sp. nov.	28 pairs	j5, j6, J2, J5, z5, z6	long	simple	simple or slightly pilose	simple or slightly pilose	1.32 (341.0/258.7)	simple
<i>M. subcoenosus</i> Takaku, sp. nov.	29 pairs	j6, J2, J3, J5, z6***	long	pilose	pilose	pilose	1.22 (350.5/287.9)	simple or pilose

\*: I judged the length of dorsal seta z1 of *M. banaticus*, *biharicus*, *margaretae*, *montanus*, and *submotus* from only figures of these species. Setal length is expressed as "long" when z1 reaching or surpassing the base of j2.

\*\* : Ventrianal shield L/W = ratio of the length of the shield to the width. Measurements are shown in parentheses in  $\mu\text{m}$ .

\*\*\*: Dorsal setae j6, J5 and z6 of *M. subcoenosus* are sometimes slightly pilose.